



EXTENSION

Update from the UVM Research Team

to the Payment of Ecosystem Services and Soil Health Working Group

December 7th, 2021



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Today's updates from UVM

- Task 2: Soil Health Scenarios
- Task 3: Farmer WTA Survey and Stakeholder Engagement
- Task 5: Ecosystem Services Valuation Study
- Task 6: PES Program Review



Some
reflection on
process



Analysis

- "resolution of anything complex into simple elements"
- literally "a breaking up, a loosening, releasing,"
- "unloose, release, set free; to loose a ship from its moorings,"



Synthesis

- "composition, a putting together,"
- "to set, put" ... "a combination of parts into a whole."



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Task 2: Soil health scenarios report update

- Build scenarios to illustrate how Vermont farm management influences soil health performance at the field scale.
- Focus these scenarios on the soil health metrics identified by the PES Soil Health Task Group



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Task 2: Illustrating Soil Health Management Scenarios at the Field Scale

- **1) Corn BMP (CC/ no-till /manure VS just manure)**
 - UVM research plots at Borderview Farm (Heather Darby)
- **2) Corn/Hay rotation VS continuous corn**
 - UVM research plots at Borderview Farm (Heather Darby)
- **3) Transition to pasture (from annuals to perennial forages)**
 - UVM research at Philo Ridge Farm (Juan Alvez)
- **4) Cover cropping in vegetable production**
 - High biomass cover cropping research by Natalie Lounsberry (UNH)
 - Potentially cover crop rotations if we can find good data (Becky Maden)
- **5) Hay with manure vs no manure (& inhibitors to reduce emissions)**
 - UVM research plots



Scenario #1: Corn BMP

Best Management Practice: No-till and Cover crop

**SOURCE OF
INFORMATION**

UVM Extension Northwest Crops and Soils Team
Research plots at Borderview Farm:
Integrating Cover Crops and Manure into Corn Silage Cropping Systems

Location and soil type:

Borderview Research Farm in Alburgh, Vermont
Benson rocky silt loam

**Land use and
management history:**

Prior to implementation of this research, the area was planted with corn silage in a conventional tillage operation.

Scenario #1: Corn BMP

Best Management Practice: No-till and Cover crop

Detailed description of management or treatments and study design:

The experimental design was a randomized complete block with replicated treatments of corn grown in various cropping systems. A best management practices (BMP) scenario of ***no-till and cover-cropped corn was grown alongside aa 'business as usual' scenario with conventional tillage and no cover crop.***

Both of these treatments had ***spring applied manure***. Other management treatments were included in this study but not described in this summary. Plots were 10' x 40' and replicated four times over three years.

Time period of data collection:

3 years, Between fall of 2017 and the fall of 2020

Summary of influence on soil health:

BMP practices resulted in higher ***aggregate stability, organic matter, soil respiration***, and an overall higher CASH soil health score than business as usual (83.4, very high functioning vs 78.0, high functioning).

Scenario #1: Corn BMP

Best Management Practice: No-till and Cover crop

Organic matter	Over three years the accumulated effects were a <i>net increase of 0.3% organic matter</i> in the BMP treatment. Business as usual: 4.07% BMP: 4.37%
Bulk density	Penetrometer data for 2020 was not statistically significantly different.
Aggregate stability	Over three years the accumulated effects were a <i>net increase of 11.1% in water stable aggregates</i> in the BMP treatment Business as usual: 29.9% BMP: 41.0%
N2O & CO2 emissions	n/a
Soil biodiversity	No measure of biodiversity was collected. Over three years the accumulated effects were a <i>net increase of 0.170 mg CO₂ g soil⁻¹ in soil respiration</i> for the BMP treatment. Business as usual: 0.567 CO ₂ g soil ⁻¹ BMP: 0.737 CO ₂ g soil ⁻¹

Scenario #2: Corn Hay Rotation

**SOURCE OF
INFORMATION**

UVM Extension Northwest Crops and Soils Team
Long term research plots at Borderview Farm:
Corn Cropping Systems to Improve Economic and Environmental Health.

Location and soil type:

Borderview Research Farm in Alburgh, Vermont
Amenia silt loam, 0-2% slope

**Land use and
management history:**

Long term research plots since 2008, previously in corn or alfalfa/fescue

Scenario #2: Corn Hay Rotation

Detailed description of management or treatments and study design:

Replicated treatment plots monitored soil health *in long-term corn-hay rotations alongside a continuous tilled corn treatment*, and other corn cropping treatments. The experimental design was a randomized complete block with replicated treatments of corn grown in various cropping systems.

Two corn-hay rotation treatments, in a 5-year hay to 5-year corn rotation, were part of this study. The only difference between them being that they are on different years in the rotation. In 2020, one of the corn-hay treatments rotated into hay from corn, and the other from corn to hay.

Time period of data collection:

The report reflects one year of data, but research on this trial has spanned 11 years, 2012 – 2021

Summary of influence on soil health:

Organic matter, aggregate stability and soil biological activity (measured through respiration) were all significantly greater in the corn-hay rotation compared to continuous corn. Soil health indicators overall were best in the rotation treatment in its first year out of sod. Bulk density was not different between treatments.

Scenario #2: Corn Hay Rotation

Organic matter	Net additional 0.25% to 1.22 % organic matter compared to continuous corn treatment (<i>significant to $p=0.1$</i>). Continuous Corn: 3.31% Rotation, coming out of 5 years hay: 4.53% Rotation, coming out of 5 years corn 3.55%
Bulk density	No significant difference observed between treatments for bulk density samples collected in 2021.
Aggregate stability	Net additional 9.4% to 41.3 % aggregate stability compared to continuous corn treatment (<i>significant to $p=0.1$</i>). Continuous Corn: 33.3% Rotation, coming out of 5 years hay: 74.6% Rotation, coming out of 5 years corn: 42.7%
N2O & CO2 emissions	n/a
Soil biodiversity	No measure of biodiversity was collected. Net additional 0.489 to 0.623 CO₂ g soil⁻¹ respiration compared to continuous corn treatment (<i>significant to $p=0.1$</i>). Continuous Corn: 0.537 CO ₂ g soil ⁻¹ Rotation, coming out of 5 years hay: 1.16 CO ₂ g soil ⁻¹ Rotation, coming out of 5 years corn: 0.671 CO ₂ g soil ⁻¹

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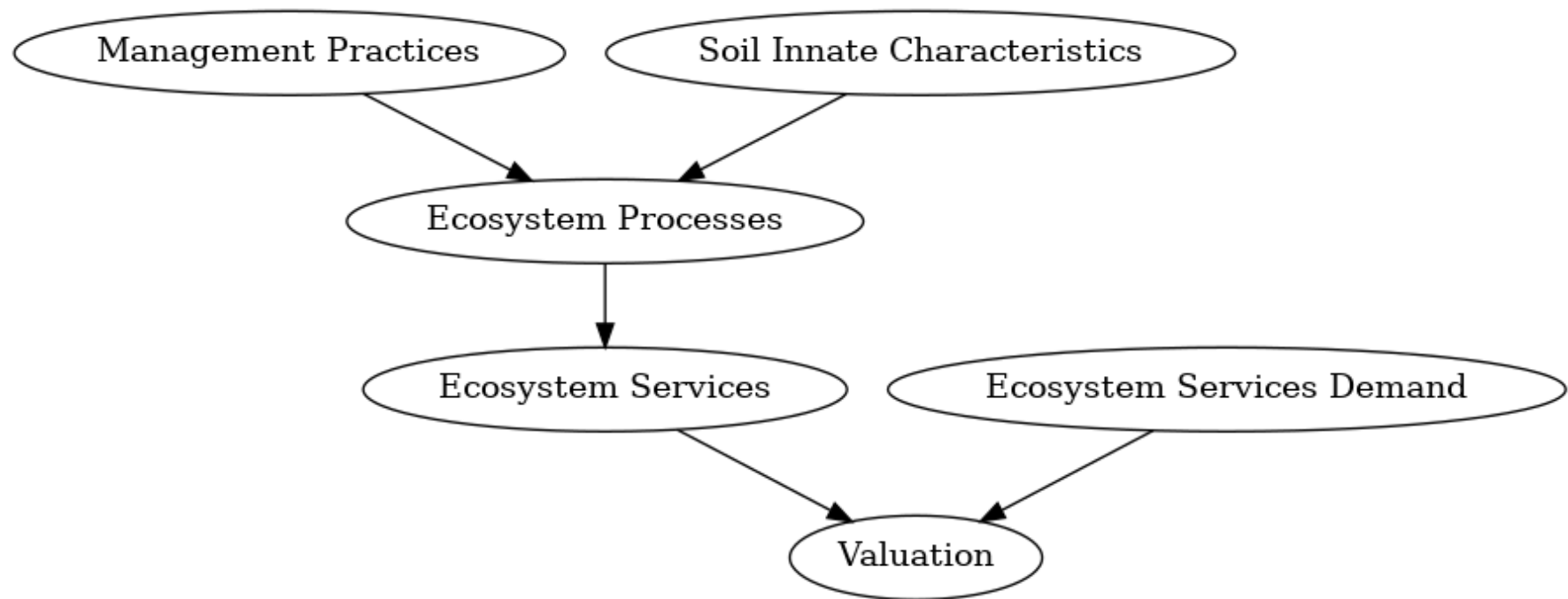
Thank you.

Please reach out with any questions or ideas!

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Conceptual Model for Task 5



Payment for Ecosystem Services Review

December 7, 2021

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The University of Vermont

LIST OF PROGRAMS

1. BushTender
2. CA Healthy Soils Initiative
3. Conservation Stewardship Program
4. Forest Carbon Project
5. Glastir
6. Lake Taupo
7. Soil and Water Outcomes Fund
8. Sustainable Farming Incentive
9. Truterra
10. Vermont Payment for Phosphorus Program



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CALIFORNIA'S HEALTHY SOILS PROGRAM INCENTIVE PROGRAM

"A COLLABORATION OF STATE AGENCIES AND DEPARTMENTS TO PROMOTE THE DEVELOPMENT OF HEALTHY SOILS ON CALIFORNIA'S FARMLANDS AND RANCHLANDS."

- A manifestation of California's 2015 Healthy Soils Initiative
- Managed by California Department of Food and Agriculture
- Funded through CA Cap and Trade proceeds
- Goal: Reduced GHG emissions at 40% below 1990 levels by 2030
- Payments are based on type of operation and depth of practice
- Solicits new practices from public to be eligible for payment
- CDFA HSP Re-Plan Tool streamlines project application process



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CARBON AGGREGATION PROJECT “YOU ONLY SEE WHAT YOU KNOW, LOVE WHAT YOU SEE, AND PROTECT WHAT YOU LOVE,” N. PATCH

- An extension of Cold Hollow to Canada (2009)
- Made possible through a high level of collaboration among VLT, Forest Legacy Program, Northeast Wilderness Trust, landowners, and others
- Also known as the Forest Carbon Project
- Unique in that it aggregates landowners and markets ecosystem services through “charismatic carbon” stories
- Next steps: pilot project to purchase no-till grassland easements for the carbon market



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SOIL AND WATER OUTCOMES PROJECT “COST EFFECTIVE SOLUTIONS FOR SOIL AND WATER STEWARDSHIP.”

- A manifestation of Iowa's 2013 Nutrient Reduction Strategy (2019)
- Limit on number of acres in program due to funding, location specific
- Buyers include corporations, municipalities, state departments of agriculture, and the federal government
- Half the payment is given in the beginning of the season to off-set costs and the last half after practices have been verified
- In the first year of implementation (2021), 9,500 acres were enrolled, 6,407 metric tons of CO₂e were sequestered, 172,794 lbs of nitrogen were reduced, and 11,651 lbs of phosphorus were reduced
- Goal: Reach 7 million acres by 2030



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TRUTERRA “FARMER OWNED, FARMER-DRIVEN, SUSTAINABILITY-FOCUSED”

- Launched by Land O'Lakes Sustain in 2016
- Collaborates with over 40 entities (companies, ag retailers, and public-private partnerships with government organizations) to meet SDG or SRP goals
- Present in 19 states
- Amount of payment and what is being paid for depends on the buyer or program
- 19,000 farmers have enrolled 1,840,000 acres on 29,000 fields
- Truterra and Land O'Lakes “touch 25% of all row crop farmers and 50% of the harvested acres”



LAKE TAUPU NITROGEN TRADING

- Ongoing compliance-based project started in 2011 in the Lake Taupo catchment area of New Zealand
- Constrain agricultural Nitrogen (N) by assigning nitrogen discharge allowances (NDAs) to farmers based on software (Overseer) modelling.
- Allow landowners to buy, sell, or lease NDAs within the catchment.
- Lake Taupo Protection Trust purchased NDAs from farmers and changed land use in order to achieve goal of 20% N reduction in the area.
- Nitrogen reduction goal achieved in 2015, however the cap-and-trade program is still in effect



VERMONT PAY-FOR-PHOSPHORUS PROGRAM

- Pay for performance program beginning in Fall, 2021 with an incentive payment for enrollment up to \$5,000.
- Eligible for farmers with up-to-date NMPs and who are in compliance with RAPs.
- Pays farmers for the pounds of phosphorus reduced by implementing conservation practices or improved nutrient management.
 - Historic TMDL management scenarios will act as the individual farmer's threshold, and payments are made for reductions beyond the threshold.
- Aims to work alongside existing state and federal assistance programs such as EQIP and FAP.

SUSTAINABLE FARMING INCENTIVE (PILOT)

- Pay for practice program administrated by the British government beginning in Fall, 2021.
- Eligible for farmers without existing agri-environment agreements on their land.
- Farmer selects land to enroll and chooses any or all of eight standards, such as the "arable and horticultural soils" standard.
- Farmers then decides on level, each requiring certain practices and monitoring.
- Farmer will be paid for completing all of the actions on all that land.
- Program also pays farmers \$5,000 in the first year for learning activities.

Level	Payment per hectare
Introductory	£26
Intermediate	£41 (Introductory plus £15)
Advanced	£60 (Intermediate plus £19)

<https://www.gov.uk/guidance/arable-and-horticultural-soils-standard>



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GLASTIR

- Government funded. When first implemented, Glastir replaced all previous existing farm-support programs
- The program is practice based, but outcomes were measured on a sample of Welsh farms from 2013-16
- Focus services: Biodiversity, Soil, Water, Greenhouse gases, Woodlands, Access and Recreation
- Whole farm program. Practices have different point values, selected practices must reach a 28 pt threshold
- £35 per hectare (US\$19.49 per acre)
- 'Regional option' has fewer practices to implement based on region-specific resource concerns, but 10% greater payments
- Complaints—too prescriptive, not enough farmers involvement, schemes were too inflexible to accommodate weather, market variability, etc.



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Conservation Stewardship Program

- Funded through the Farm Bill since 2008
- No minimum acreage required, must meet 'stewardship threshold' for at least 2 priority resource concerns
- Practice based
- Farms are ranked through Conservation Application Ranking Tool (CART), selects based on resource concerns and gives point values based on resource conditions, current practices, and on-site observation
- Point score is compared with stewardship threshold, farmer then chooses best practices to implement
- If application is approved, NRCS works with farmer to make conservation plan, which farmer is obligated to carry out.
- Payments are delivered yearly, contingent on practice implementation

BushTender

- Founded in 2001
- Focus is on Biodiversity of Native Vegetation
- Reverse Auction
 - landowner receives a management plan after site assessment
 - Landowner submits bid for implementing the plan, with expenses determined by the farmer
 - Applications rank according to environmental return
- Landowners often underbid, end up not fully compensated



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KEY TABLE CATEGORIES

Table 1. General Program Information

- Name, location, year founded, financing, etc.

Table 2. Market Information

- Market type, performance or practice, ES paid for

Table 3. Program Details

- Eligibility requirements, contract duration, etc.

Table 4. Required Data and Verification Methods

- Required data, modeling software, verification schedule, etc.

Table 5. Payment Information

- Payment range, payment per unit, other payments to producers

Table 1. General Program Information

Program Name	Location	Year Founded	Primary Organization(s)	Financing ¹	Program Type
BushTender	Victoria, AU	2001	Dept. of Sustainability & Environment	Government	Voluntary
CA Healthy Soils Program (CA HSP)	California	2016 ²	California Department of Food and Agriculture	Compliance	Voluntary
Conservation Stewardship Program (CSP)	U.S.	2008	USDA NRCS	Government	Voluntary
Forest Carbon Project	Vermont	2009	Cold Hollow to Canada & Vermont Land Trust	User	Voluntary
Glastir	Wales, UK	2009	Welsh Assembly Government	Government	Voluntary
Lake Taupo	Lake Taupo catchment area, New Zealand	2011	Lake Taupo Protection Trust	Government	Compliance with voluntary components
Soil and Water Outcomes Fund	Particular counties in Illinois, Iowa, Ohio, and the Chesapeake Watershed ³	2019 ⁴	Iowa Department of Agriculture and Land Stewardship (IDALS)	Users, including government municipalities	Voluntary
Sustainable Farming Incentive	England	2021	Department for Environment Food and Rural Affairs	Government	Voluntary
Truterra/Land O'Lakes	National	2016	Land O'Lakes Sustain	User or mixed user-government	Voluntary
Vermont Payment for Phosphorus Program	Vermont	2021	Vermont Agency of Agriculture, Food and Markets	Compliance and Government	Voluntary

1. Financing is either categorized as user, government, or compliance.

2. Founded in 2016 due to 2015 CA Healthy Soils Initiative.

3. Eligible counties within the Chesapeake Watershed are in the following states: Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia.

4. Created as a result of Iowa's 2013 Nutrient reduction strategy.

RECOMMENDATION: Prioritize Fairness

Access

1. Design payments to accommodate varying financial needs
2. Support for New and Historically Underserved Farmers (CSP) (Ranking: VT PfP)
3. Adjusted payment rates to account for farm size (Gund)

Communication

1. Publicization (CSP)
2. Include robust technical assistance to increase enrollment, participation, and training (i.e., new technology)

Eligibility

1. All farms regardless of size, location, or farm type should be eligible to apply
2. Avoid limitations to support targeting resources (Lake Taupo, VT PfP)
3. When eligibility requirements are low, consider limits on funding that may necessitate a ranking scheme in favor of different eligibility factors (CSP)
 - VT PES will likely have limitations, need to have "hard conversations"



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RECOMMENDATION: Hybridize compensation in a tiered approach to pay for practice and performance

Performance

- More autonomy and flexibility based on farm characteristics and applicability of certain conservation practices
- Verification is a mix of measurement and modeling
- Expensive for labor, admin, equipment
- Risk is on farmer (addressed through incentive payments in VT PFP)

Hybrid tiered approach

First payment tier based on practice

Subsequent tiers (higher payments based on performance)

- Autonomy on tier
- Verification depends on tier
- Expense depends on tier
- Risk depends on tier

Practice

- Less autonomy and flexibility (Glastir)
- Verification is visual
- Lower labor, admin, equipment costs because there is no need for follow-up modelling or measurements of results.
- Risk is on buyer



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RECOMMENDATION: Establish Credibility

Must be strong trust in institutions

- Trustworthiness: open communication with potential participants and transparency in all guidelines and eligibility requirements.
- Fairness: addressing accessibility based on unique farm characteristics.
- Sound verification methods: accurate measuring and modelling tools



Image: <https://ideatelabs.in/blog/keys-to-gain-credibility-as-a-leader/>

RECOMMENDATION: Guarantee Permanence

Program longevity

- Management transitions require risk and investment
- Participants need guaranteed long-term funding and access to program payments
- Long-term communication between program administrator and farmer to monitor costs and benefits to farming operation.



Image: <https://www.istockphoto.com/>

RECOMMENDATION: Administer through a government entity to create demand through regulation

Institution Capacity

- Ecosystem Service demand is often driven by regulation
 - Usually externalized in markets
 - Not driven by physical scarcity or social demand
- Many programs are administered by governments to manage regulation/demand



Image: <https://www.anzsog.edu.au/>

RECOMMENDATION: Baselines or Thresholds, TBD...

- Many trade-offs
- Thresholds are fairer
 - But buyers may be paying for actions that would occur anyway
- Baselines could limit eligibility
 - But use funding more efficiently, and payments are for actual improvements
- Ultimately depends on other program factors being determined first

